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DESIGN AND DEVELOPMENT OF UNMANNED AERIAL VEHICLE (DRONE) USING SOLAR PANEL FOR CIVIL APPLICATIONS

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ABSTRACT: UAV is defined as an aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expandable or recoverable, and can carry a lethal or nonlethal payload. It is controlled either autonomously by on-board computers or by remote control of a pilot on the ground. Its usage is currently limited by difficulties such as satellite communication and cost. A Drone has been built that can be operated by radio frequency controller and send live audio-visual feedback. Microcontroller based drone control system has also been developed where a RF transmitter and receiver operating in the frequency of 2.4 GHz are used for remote operation for the Drone.

KEYWORDS: Brushless DC motors Electronic Speed Controllers (ESC), ATmega644 Controller, MPU6050 (GTRO Sensor), Mother Board, Li-Po battery, Receivers, Transmitters, Berg Male Connectors, Solar Plate, Diodes, Resistors, Switches, LCD, PCB, camera.

INTRODUCTION

Unmanned aerial vehicles (UAV) are more properly known as Drone. Basically, drone is a flying robot. Working in combination with GPS, the flying machine may be remotely controlled or can fly autonomously by software controlled flight plans in their embedded systems. Drones are most often used in military services. However, it is also used for weather monitoring, fire fighting, search and rescue, surveillance and traffic monitoring etc. In recent years, the drone has come into attention for a number of commercial uses. In late 2013, Amazon announced a plan to use unmanned aerial vehicles for delivery in the nearby areas future. It is known as Amazon Prime Air, it is estimated to deliver the orders within 30 minutes inside 10 miles of distance. So it is clear that domestic usage of UAV has vast future possibility in different fields rather than military usage.

Quadcopter, also known as quadrotor helicopter or quadrotor, is a multirotor helicopter that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors. In a quadcopter, two of the propellers spin in one direction (clockwise) and the other two spin the opposite direction (counterclockwise) and this enables the machine to hover in a stable formation. Firstly the motors which we used have an obvious purpose: to spin the propellers. Motors are rated by kilovolts, the higher the kV rating, the faster the motor spins at a constant voltage. Next the Electric Speed controller or ESC is what tells the motors how fast to spin at any given time. We need four ESCs for a quadcopter, one connected to each motor. The ESCs are then connected directly to the battery through either a wiring harness or power distribution board. Many ESC1s come with a built in battery eliminator circuit (BEC), which allows you to power things like your flight control board and radio receiver without connecting them directly to the battery. Because the motors on a quadcopter must all spin at precise speeds to achieve accurate flight, the ESC is very important.

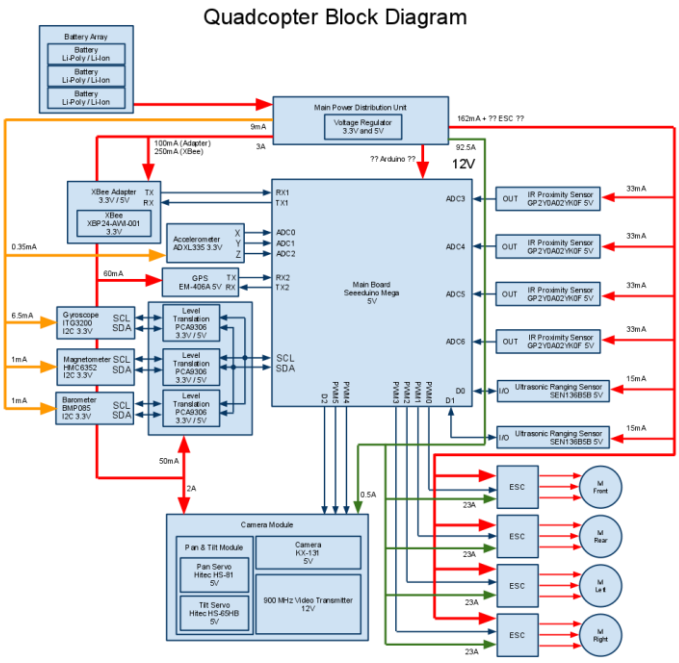


Fig1: Block Diagram

BRUSHLESS DC MOTOR

Brushless DC electric motor also known as electronically commutated motors are synchronous motors that are powered by a DC electric source by an integrated inverter or switching power supply, which produces an AC electric signal to drive the respective motor. Alternating current does not imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed).The rotor part of a brushless motor is often a permanent magnet synchronous motor, they are frequently stopped with the rotor in a defined angular position.

Fig 2: Brushless dc motor

ATMEGA644 (CONTROLLER)

This based on the simulations and characterization of other AVR microcontrollers manufactured on the same process technology. The ATmega644 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega644 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

BLOCK DIAGRAM:

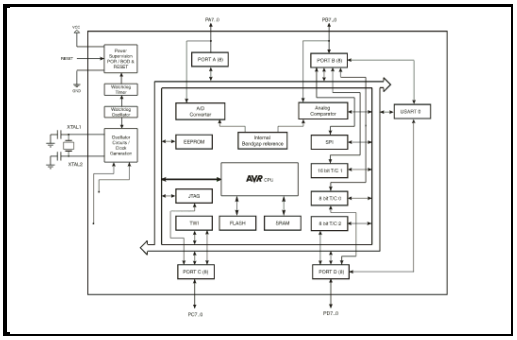


Fig 3: Block Diagram of ATmega644 (Controller).

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers. The ATmega644 provides the following features: 64 Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 2 Kbytes EEPROM, 4 Kbytes SRAM, 32 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 2 USARTs, a byte oriented 2-wire Serial Interface, a 8-channel, 10-bit ADC with optional differential input stage with programmable gain, programmable Watchdog Timer with Internal Oscillator. The On chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional non volatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the application Flash memory.

MPU6050 (GYRO SENSOR) GYROSCOPE

A gyroscope measures angular velocity (the rate of change in orientation angle), not angular orientation itself first initialize the sensor position with a known value (possibly from the accelerometer), then measure the angular velocity (ω) around the X, Y and Z axes at measured intervals (Δt) $\omega \times \Delta t$ = change in angle .The new orientation angle is the original angle plus this change. This is integrating adding up many small computed intervals to find orientation. Repeatedly adding up increments of $\omega \times \Delta t$ results in small systematic errors becoming magnified over time .Gyroscopic drift over long timescales the gyroscope data will become increasingly inaccurate. The Carioles force acts perpendicular to the rotation axis and to the velocity of the body in the rotating frame, $\mathbf{F_c = -2m\,\Omega}$, the displacement induces a change in capacitance between the mass and the housing, thus transforming the angular rate input to the gyroscope into an electrical output.

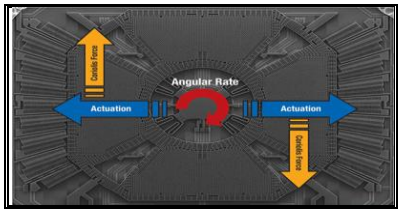
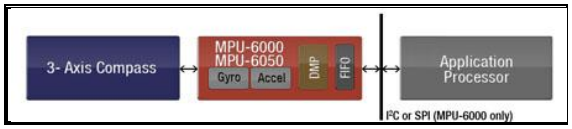


Fig4: Gyroscope

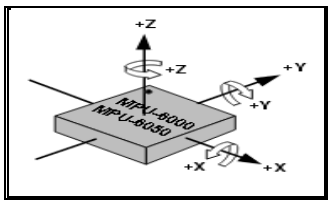
MPU-6050

The MPU-6050 is the world's first integrated 6-axis Motion Tracking device It combines a 3-axis gyroscope, 3-axis accelerometer, and a Digital Motion Processor™ (DMP) all in a small 4x4x0.9mm package. It uses a standard I2C bus for data transmission. With its I2C bus, it can accept inputs from an external 3-axis compass to provide a complete 9-axis Motion Fusion output. A number of different breakout boards are available containing the MPU-6050 chip; we have the GY-521.



ACCELEROMETERS

Accelerometers also have sensitivity, expressed in mV/g. Divide the zero-g level corrected reading by the sensitivity to produce the final reading. Mass deflection is measured as a change in capacitance between the proof mass and sensing plates. Internal circuitry converts the tiny capacitance to a voltage signal which is digitized and output. Computing orientation from an accelerometer relies on a constant gravitational pull of 1g (9.8 m/s^2) downwards. If no additional forces act on the accelerometer, the magnitude of the acceleration is 1g, and the sensor's rotation can be computed from the position of the acceleration vector. If the Z-axis is aligned along the gravitational acceleration vector, it is impossible to compute rotation around the Z-axis from the accelerometer. Digital accelerometers give information using a serial protocol like I2C, SPI or USART.



LI PO BATTERY CHARGER

A lithium polymer battery, or lithium-ion polymer battery (Li Po, LIP, Li-poly), is a rechargeable battery of lithium-ion technology in a pouch format. Unlike cylindrical and prismatic cells, Li Pos come in a soft package or pouch, which makes them lighter but also less rigid. We use 3S1P batteries, which indicate 3 cells in parallel. Each cell is 3.7 volts, so this battery is rated at 11.1 volts. Li Po batteries also have a C rating and a power rating in mAh (milliamps per hour). The C rating describes the rate at which power can be drawn from the battery, and the power rating describes how much power the battery can supply. Larger batteries weigh more so there is always a tradeoff between flight duration and total weight. A general rule of thumb is that doubling the battery power will get you 50% more flight time, assuming that quadcopter can lift the additional weight. Li Po batteries have three main things going for them that make them the perfect battery choice for RC planes and even more so for RC helicopters over conventional rechargeable battery types such as NiCad or NiMH.

Fig6: Li-Po Battery

SPECIFICATIONS

- Capacity: 3300mAh
- Voltage: 11.1V
- Max Continuous Discharge: 25C (82.5A)
- Max Burst Discharge: 50C (165A)
- Weight: 284g
- Dimensions: 133×42×23mm
- Charge Rate: 1-3C Recommended, 5C Max

TRANSMITTER

The transmitter is used for limited to equipment that generates radio waves for communication purposes; or radiolocation, such as radar and navigational transmitters. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates radio waves. A transmitter can be a separate piece of electronic equipment, or an electrical circuit within another electronic device. A transmitter and receiver combined in one unit is called a transceiver.

The purpose of most transmitters is radio communication of information over a distance. The information is provided to the transmitter in the form of an electronic signal, such as an audio (sound) signal from a microphone, a video (TV) signal from a TV camera, or in wireless networking devices a digital signal from a computer. A radio transmitter is an electronic circuit, which transforms electric power from a battery or electrical mains into a radio frequency alternating current, which reverses direction millions to billions of times per second

Fig7: Transmitter

RECEIVER

A radio receiver is an electronic circuit that receives its input from an antenna, which uses electronic filters to separate a particular radio signal from all other signals picked up by that antenna, those signal amplifies it to a level suitable for further processing, and it converts through demodulation and decoding the signal into a specific data for the consumer, such as sound, pictures, digital data, measurement values, navigational positions, etc. The receiver is the receiving end of a communication channel. It receives decoded messages/information from the sender, who firstly encoded them.

PROPELLERS

Propellers of quadcopter there arises the need of two types of propellers, to need the purpose of flight. A pair of clockwise (CW) and anticlockwise (ACW) propellers is needed. The care should be taken in the dimensions of the propellers. A propeller is a type of fan that transmits power by converting rotational motion into thrust; a pressure difference is produced between the forward and rear surfaces of the air foil-shaped blade, which used air for lifting or accelerating behind the blade.

Propeller dynamics can be modeled by both Bernoulli's principle and Newton's third law. Increased propeller pitch and length will draw more current. Also the pitch can be expressed as the travel distance of one single prop rotation. In a nutshell, higher pitch means slower rotation, but will increase the Quadcopter speed which also uses more power. When deciding on length and pitch, it need to find a good balance. Generally a prop with low pitch numbers can generate more torque. The motors don’t need to work as hard so it pulls less current with this type of prop. If you want to do acrobatics, you will need torque propellers which provide more acceleration and it puts less pressure the power system. Lower pitch propellers will also improve stability. A higher pitch propeller moves greater amount of air, which could create turbulence and cause the aircraft to wobble during hovering. If you notice this with your quadcopter, try to choosing a lower pitched propeller.

Fig8: Propellers

APPLICATIONS

ANIMAL IMITATION – ETHOLOGY

Flapping-wing ornithopters, imitating birds or insects, are a research field in micro UAVs. Their inherent stealth recommends them for spy missions. the compound insect eyes formed from multiple facets, which can transmit data to neuromorphic chips able to treat optic flow as well as light intensity discrepancies.

ENDURANCE

Because of their small size, low weight, low vibration and high power to weight ratio, Wankel rotary engines are used in many large UAVs. Their engine rotors cannot seize; the engine is not susceptible to shock-cooling during descent and it does not require an enriched fuel mixture for cooling at high power. These attributes reduce fuel usage, increasing range or payload.

WORKING

All the components are combined together and formed from circuit diagram of unmanned Arial vehicle (Drone) using solar panels. As the drone indicates solar drone solar panel absorb sun rays from sun and that refractory rays converted into the charges and that charges motivate to drive the solar drone. Also drone is fly upward from ground by using brushless DC motor drives the propellers the propellers are move with respect to construction of its own in supports of DC motors are rotated either clockwise or anticlockwise direction. As the propellers rotated at rated speed and hence solar drone moves upward.

Due to specification of camera built in solar drone, it has capturing phenomenon they receiving the information which we have to search, in environments and we have controlling remote which controls the movements of solar drone with respect to requirements of people.

ADVANTAGES

- Real time imaginary, assistance for ground force.
- Natural disaster for the surveillance of survivors.
- Atmospheric and scientific research.
- Transportable.

DISADVANTAGES

- Civilian’s death.
- Lightweight, susceptible to high winds and precipitation.
- Loss of respect for foreign soldiers.
- Decision making issue.

CONCLUSION

Main aim of this project was to develop a Drone which can be used in several surveillance purposes and deliver light weight products. For controlling the Drone, 2.4 GHz radio frequency transmitter, receiver, microcontroller, electronic speed controller, brushless DC motor and servo motor have been used. Drones are the future of unmanned surveillance and warfare. Different types and1. Tice, Brian P. (Spring 1991). "Unmanned Aerial Vehicles –The Force Multiplier of the 1990s". Airpower Journal. Archived from the original on 24 July 2009. Retrieved 6 June 2013. When used, UAVs should generally perform missions characterized by the three Ds: dull, dirty, and dangerous.

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